

TRANSCRANIAL BRAIN STIMULATION TECHNIQUES FOR TREATMENT OF MENTAL DISORDERS

V. De Santis

Dept. of Industrial and Information Engineering and Economics, University of L'Aquila
Piazzale Ernesto Pontieri, Monteluco di Roio, 67100 L'Aquila, Italy

Transcranial brain stimulation techniques in patients affected by mental disorders (such as Alzheimer, Parkinson, schizophrenia, autism, depression,...) are getting more and more attention at national, EU, and worldwide level. Among several transcranial stimulation techniques, the most used ones are the transcranial Direct Current Stimulation (tDCS) and the Transcranial Magnetic Stimulation (TMS), this because they are non-invasive, painless (or with less side-effects compared to other stimulation techniques) and relatively cheaper. Thus, several EU projects have been funded on this topic and the number of publications and patents has been notably increased as well in recent years.

In this context, the UniAQ, together with Aalto University, has developed a numerical tool to evaluate the inter-subject variability in the electric field induced in the brain of several patients under tDCS [1]. Later on, another collaboration with the Sapienza University of Rome investigated the effect of skin conductivity on the electric field induced by transcranial stimulation techniques (both tDCS and TMS) in different head models [2]-[3].

Recently, more focus has been paid on the TMS technique, with a possible application for the treatment of depression in patients affected by long-covid disease [4]. Finally, a collaboration with the ENEA, CNR Casaccia, has been started to address the numerical issues in commercial software using structured or rectilinear grid discretization versus those using unstructured or mesh discretization techniques [5]-[6].

References

- [1] I. Laakso, S. Tanaka, S. Koyama, V. De Santis, and A. Hirata, "Inter-subject variability in tDCS electric fields," *Brain Stimulation*, vol. 8, no. 5, pp. 906-913, Sept. 2015.
- [2] A. Paffi, M. Colella, M. Mambrini, F. Apollonio, V. De Santis, and M. Liberti, "Numerical evaluation of the induced electric field in techniques of transcranial brain stimulation: influence of the anatomic model and skin conductivity," 3rd International Brain Stimulation Conference, 24-27 February 2019, Vancouver, Canada.
- [3] M. Colella, A. Paffi, V. De Santis, F. Apollonio, and M. Liberti, "Effect of skin conductivity on the electric field induced by transcranial stimulation techniques in different head models," *Physics in Medicine and Biology*, vol. 66, no. 3, Jan. 2021.
- [4] V. De Santis, "A sensitivity analysis on the electric field induced in the brain by TMS for long COVID treatment," BioEM 2023, 18-23 June 2023, Oxford, United Kingdom.
- [5] F. Camera, C. Merla, and V. De Santis, "Comparison of TMS Dosimetry Between Structured and Unstructured Grids Using Different Solvers," BioEM 2024, 16-21 June 2024, Crete, Greece.
- [6] F. Camera, C. Merla, and V. De Santis, "Comparison of Transcranial Magnetic Stimulation Dosimetry Between Structured and Unstructured Grids Using Different Solvers," *Bioengineering*, vol. 11, no. 7, p. 712, 2024.